

In the claims:

1. (Previously presented) A multi-module pipe repair inspection device, comprising:
- a base module;
  - a microprocessor;
  - at least two interchangeable tooling modules;
  - a first flexible joint having electrical connection means, said joint flexibly, electrically and releasably connecting the base module to a selected one of the interchangeable tooling modules; and,
  - a second flexible joint having electrical connection means, said joint flexibly, electrically and releasably connected between the interchangeable tooling modules.
2. (Withdrawn) The device of claim 1, further comprising a locomotor module positioned between the base module and the tooling module.
3. (Withdrawn) The device of claim 1, wherein the tooling module is a camera module.
4. (Withdrawn) The device of claim 3, further comprising a centralizer connected to the camera module.
5. (Withdrawn) The device of claim 2, wherein the locomotor has a stepper motor.
6. (Withdrawn) The device of claim 1 wherein the tooling module is a marker module connected to the base module and the device further comprises an MFL module connected to a marker module.
7. (Withdrawn) The device of claim 6, further comprising a locomotor module connected between the base module and the marker module.
8. (Withdrawn) The device of claim 7, further comprising a flexible joint connected between the locomotor module and the marker module.
9. (Withdrawn) The device of claim 6, further comprising a flexible joint connected between the MFL module and the marker module.
10. (Withdrawn) The device of claim 6, further comprising a centralizer connected to the marker module.
11. (Withdrawn) The device of claim 6, wherein the marker module includes:
- a gas source;

- a regulator connected to the gas source;
- a marker valve connected to the gas source;
- a purge valve connected to the gas source;
- a marker reservoir tank connected to the marker valve;
- a check valve connected to the purge valve; and
- a nozzle head connected to the check valve.

12. (Previously presented) The device of claim 1, wherein the interchangeable tooling modules comprise:

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- a sensor module connected to the base module; and
- a brush module connected to the sensor module.

13. (Cancelled)

14. (Currently Amended) A multi-module pipe repair inspection device, comprising:

a base module;

a microprocessor;

at least two interchangeable tooling modules;

a first flexible joint having electrical connection means, said joint flexibly, electrically and releasably connecting the base module to a selected one of the interchangeable tooling modules; and,

a second flexible joint having electrical connection means, said joint flexibly, electrically and releasably connected between the interchangeable tooling modules,

wherein each of said first and second joints is comprised of end portions, a spring positioned between said end portions defining a passage therethrough, and a flexible wire for electrically interconnecting adjacent modules to pass control and feedback signals from one module to another.

15. (Previously presented) The device of claim 12, further comprising an interchangeable locomotor module connected between the base module and the sensor module by additional flexible joints.

16. (Original) The device of claim 12, further comprising a centralizer connected to the sensor module.

17. (Original) The device of claim 12, wherein the brush module includes a camera.
18. (Original) The device of claim 12, wherein the brush module includes a brush assembly, the brush assembly including at least one star-shaped brush wheel.
19. (Original) The device of claim 18, wherein the brush wheel is constructed of hardened steel.
20. (Original) The device of claim 18 wherein the brush assembly further includes a spring, wherein the spring keeps the brush wheel from contacting a wall of a pipe, and wherein rotation of the brush assembly causes tension on the spring to be overcome and the brush wheel contacts the wall of the pipe.
21. (Withdrawn) The device of claim 1 wherein the tooling module is a patch set/test module.
22. (Cancelled)
23. (Withdrawn) The device of claim 21, wherein the patch set/test module includes a bladder module and a supply module connected to the bladder module.
24. (Withdrawn) The device of claim 23, further comprising a flexible joint connected between the bladder module and the supply module, said joint having means for fluid connection between the bladder and supply modules.
25. (Withdrawn) The device of claim 23, wherein the supply module includes at least one tank and a regulator for regulating gas entry and exit from the tank.
26. (Withdrawn) The device of claim 23, wherein the bladder module includes an inflatable bellows for setting a patch to a wall of a pipe.
27. (Withdrawn) The device of claim 21, further comprising a locomotor module connected between the base module and the patch set/test module.
28. (Withdrawn) A multi-module pipe inspection and repair device, comprising:
- a base module;
  - a camera module;
  - a sensor module;
  - an MFL module;
  - a brush module;
  - a patch set/test module;
  - a marker module; and

wherein each of the modules may be interconnected to construct one of an inspection device, a preparation device, a marking device, and a repair device.

29. (Withdrawn) The device of claim 28, further comprising a locomotor module.
30. (Withdrawn) The device of claim 28, further comprising at least one flexible connector for connecting at least two of the modules.
31. (Withdrawn) The device of claim 28, further comprising at least one centralizer connected to at least one of the modules.
32. (Withdrawn) A method of repairing a pipe, comprising:  
attaching a patch to a multi-module pipe inspection and repair device;  
inserting the device into the pipe;  
locating a flaw in the pipe using the device;  
preparing the flaw for repair using the device;  
patching the flaw with the patch using the device; and  
removing the device from the pipe.
33. (Withdrawn) A method of repairing a pipe, comprising:  
inserting a marking device into the pipe;  
marking at least one flaw in the pipe using the marking device;  
removing the marking device from the pipe;  
inserting a preparation device into the pipe;  
preparing the flaw for repair using the preparation device;  
removing the preparation device from the pipe;  
inserting a patch module having a patch into the pipe;  
repairing the flaw using the patch module; and  
removing the patch module from the pipe.
34. (Withdrawn) The method of claim 33, further comprising preparing the pipe.
35. (Withdrawn) The method of claim 34, wherein preparing the pipe includes attaching an access system to the pipe and removing a portion of the pipe proximate the access system.
36. (Withdrawn) The method of claim 33, further comprising:  
inserting an inspection device into the pipe;

inspecting the pipe using the inspection device; and  
removing the inspection device.

37. (Withdrawn) The method of claim 33, wherein inserting a marking device into the pipe includes inserting a marking device having a base module, a marker module connected to the base module, and an MFL module connected to the marker module.

38. (Withdrawn) The method of claim 33, wherein inserting a preparation device into the pipe includes inserting a preparation device having a base module, a sensor module connected to the base module, and a brush module connected to the sensor module.

39. (Withdrawn) The method of claim 33, wherein inserting a patch module having a patch into the pipe includes inserting a patch module having a base module, a supply module connected to the base module, and a bladder module connected to the supply module.

40. (Withdrawn) The method of claim 36, wherein inserting an inspection device into the pipe includes inserting an inspection device having a base module and a camera module connected to the base module.

41. (Withdrawn) The method of claim 33, wherein preparing the flaw for repair using the preparation device includes abrading a wall of the pipe where the flaw is located.

42. (Withdrawn) The method of claim 33, wherein marking at least one flaw in the pipe using the marking device includes marking at least one flaw in the pipe with paint.

43. (Withdrawn) The method of claim 33, wherein repairing the flaw using the patch module includes affixing a flexible patch to a wall of the pipe.

44. (Withdrawn) A pipe inspection and repair system, comprising:

a coiled tubing unit having coiled tubing piping;

a user interface in communication with the coiled tubing unit;

a pipe access system connected to a pipe;

a multi-module pipe inspection and repair device connected to the coiled tubing piping and adapted to enter the pipe through the pipe access system.

45. (Withdrawn) The system of claim 44, further comprising an interface connector connected between the coiled tubing unit and the device.

46. (Withdrawn) The system of claim 44, wherein the device includes:

a base module;  
a camera module;  
a sensor module;  
an MFL module;  
a brush module;  
a patch set/test module;  
a marker module; and

wherein each of the modules may be interconnected to construct one of an inspection device, a preparation device, a marking device, and a repair device.

47. (Withdrawn) The system of claim 46, wherein the device further includes a locomotor module.

48. (Withdrawn) The system of claim 44, wherein the user interface includes:

a controller board;  
a user interface board in communication with the controller board;  
a control panel in communication with the user interface board; and  
a monitor in communication with the controller board.

49. (Withdrawn) The system of claim 44, wherein the pipe access system includes:

a sleeve attached to the pipe, the sleeve having a protruding portion;  
a valve assembly connected to the protruding portion; and  
an access tube connected to the valve assembly.

50. (Withdrawn) The system of claim 49, wherein the protruding portion is oriented at approximately a 20 degree angle relative to the pipe.

51. (Withdrawn) The system of claim 49, wherein the valve assembly includes one of a ball valve and a gate valve.

52. (Withdrawn) The system of claim 44, wherein the coiled tubing unit includes:

a tether spool;  
a slip ring in communication with the spool and the user interface; and  
a tether odometer in communication with the user interface.

53. (Withdrawn) A joint for connecting at least two modules of a multi-module pipe inspection and repair device, comprising:

- an end shell;
- a locking sleeve;
- a spring connected between the end shell and the locking sleeve; and
- a mesh connected between the end shell and the locking sleeve; wherein the mesh substantially surrounds the spring.

54. (Withdrawn) The joint of claim 53, wherein the locking sleeve includes at least one connector.

55. (Withdrawn) The joint of claim 53, wherein the spring creates a void, and further comprising a bundle connected to the locking sleeve, wherein the bundle is adapted to pass at least one of a fluid, a gas, and an electrical signal.

56. (Withdrawn) The device of claim 1 wherein the flexible joint comprises

- an end shell;
- a locking sleeve;
- a spring connected between the end shell and the locking sleeve; and
- a mesh connected between the end shell and the locking sleeve; wherein the mesh substantially surrounds the spring.

57. (Withdrawn) The device of claim 56 wherein the locking sleeve includes the electrical connection means.

58. (Withdrawn) The device of claim 56 wherein the spring defines a passage, and the electrical connection means comprises a bundle connected to the locking sleeve, wherein said bundle is configured to pass at least one electrical signal and optionally, at least one fluid.

59. (Withdrawn) The device of claim 1 further comprising a coiled tubing unit having coiled tubing piping and an interface connector connected between the coiled tubing unit and the base module.

60. (Withdrawn) The device of claim 59 further comprising:

- a user interface in communication with the coiled tubing unit; and,
- a pipe access system connected to a pipe.

61. (Withdrawn) The system of claim 60, wherein the user interface includes:
- a controller board;
  - a user interface board in communication with the controller board;
  - a control panel in communication with the user interface board; and
  - a monitor in communication with the controller board.
62. (Withdrawn) The system of claim 60, wherein the pipe access system includes:
- a sleeve attached to the pipe, the sleeve having a protruding portion;
  - a valve assembly connected to the protruding portion; and
  - an access tube connected to the valve assembly.
63. (Withdrawn) The system of claim 62, wherein the protruding portion is oriented at approximately a 20 degree angle relative to the pipe.
64. (Withdrawn) The system of claim 62, wherein the valve assembly includes one of a ball valve and a gate valve.
65. (Withdrawn) The system of claim 59, wherein the coiled tubing unit includes:
- a tether spool;
  - a slip ring in communication with the spool and the user interface; and
  - a tether odometer in communication with the user interface.
66. (Withdrawn) The device of claim 3 further comprising a marker module connected to the camera module and an MFL module connected to a marker module.
67. (Withdrawn) The device of claim 3 further comprising a sensor module connected to the camera module and a brush module connected to the sensor module.
68. (Withdrawn) The device of claim 67 further comprising a patch set/test module.
69. (Withdrawn) The device of claim 68 further comprising flexible connectors for connecting each module to the module adjacent thereto.
70. (Withdrawn) The device of claim 69 wherein the flexible joint comprises
- an end shell;
  - a locking sleeve;



a spring connected between the end shell and the locking sleeve defining a passage;  
a mesh connected between the end shell and the locking sleeve; wherein the mesh substantially surrounds the spring;

the electrical connection means further comprising a bundle connected to the locking sleeve, wherein said bundle is configured to pass at least one electrical signal and optionally, at least one fluid through said passage.

71. (Withdrawn) The device of claim 28, further comprising flexible connectors for connecting each module to the module adjacent thereto.

72. (Withdrawn) The device of claim 28, further comprising at least one centralizer connected to each of the modules.

73. (Previously presented) The device of claim 14 wherein said flexible wire passes through said passage and further comprising a sleeve positioned in said passage for shielding said flexible wire.

74. (Previously presented) The device of claim 14 further comprising a member substantially surrounding said spring.

75. (Previously presented) The device of claim 74 wherein said member is formed of wire mesh.

76. (Previously presented) The device of claim 74 wherein said member is formed of cords fastened together.

77. (Previously presented) A multi-module pipe repair inspection device, comprising:

a base module;

a microprocessor;

an interchangeable sensor module connected to the base module;

an interchangeable brush module connected to the sensor module;

first and second flexible joints, each joint having electrical connection means, said first joint flexibly, electrically and releasably connecting the base module to the sensor module, and said second joint flexibly, electrically and releasably connecting the sensor module to the brush module, each said joint being comprised of end portions, a spring positioned between said end

portions defining a passage therethrough, and a flexible wire bundle for electrically interconnecting the adjacent modules to pass control and feedback signals therebetween.

78. (Previously presented) The device of claim 77 wherein said flexible wire bundle passes through said passage and further comprising a sleeve positioned in said passage for shielding said flexible wire bundle.

79. (Previously presented) The device of claim 77 further comprising a member substantially surrounding said spring.

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80. (Previously presented) The device of claim 79 wherein said member is formed of wire mesh.

81. (Previously presented) The device of claim 79 wherein said member is formed of cords fastened together.

82. (Previously presented) The device of claim 77 further comprising means surrounding said spring for providing angular detention to prohibit over-rotation or over-translation of said spring.

83. (Previously presented) The device of claim 82 wherein said means for providing angular detention is formed of wire mesh.

84. (Previously presented) The device of claim 82 wherein said means for providing angular detention is formed of cords fastened together.

85. (Previously presented) The device of claim 12 further comprising:  
a camera and lighting positioned on said base module.

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